

REMARKS

The Office Action dated January 21, 2005, has been received and reviewed.

Claims 1-28 are currently pending and under consideration in the above-referenced application. Each of claims 1-28 stands rejected.

Reconsideration of the above-referenced application is respectfully requested.

Rejections Under 35 U.S.C. § 103(a)

Claims 1-28 stand rejected under 35 U.S.C. § 103(a).

The standard for establishing and maintaining a rejection under 35 U.S.C. § 103(a) is set forth in M.P.E.P. § 706.02(j), which provides:

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Chen in View of Danek

Claims 1, 8-10, 12-14, 18-20, 23, and 25-28 are rejected under 35 U.S.C. § 103(a) for reciting subject matter which is assertedly unpatentable over the subject matter taught in U.S. Patent 6,020,259 to Chen et al. (hereinafter "Chen"), in view of teachings from U.S. Patent 6,699,530 to Danek et al. (hereinafter "Danek").

Chen teaches a process that include selectively depositing titanium silicide on a surface of a silicon substrate that is exposed through a contact opening, then blanket depositing titanium nitride over the interconnect. Chen does not include any teaching or suggestion that these deposition processes may be effected *in situ*.

The teachings of Danek are directed to processes in which a diffusion barrier is formed by depositing a material, annealing the material, and oxidizing or stuffing silicon atoms into the

material *in situ*. While Danek teaches that deposition and annealing processes may be repeated to form a multi-layer diffusion barrier, Danek does not teach or suggest that a metal silicide may be formed and an interconnect material deposited *in situ*, with the interconnect material being deposited after then metal silicide is formed.

In view of the foregoing, it is respectfully submitted that the teachings of Chen and Danek do not support a *prima facie* case of obviousness against any of claims 1, 8-10, 12-14, 18-20, 23, or 25-28.

In particular, it is respectfully submitted that Chen and Danek, taken either together or separately, do not teach or suggest each and every element of any of claims 1, 8-10, 12-14, 18-20, 23, or 25-28.

With respect to independent claim 1, neither Chen nor Danek teaches or suggests that an interconnect material may be deposited after and *in situ* with the selective deposition of metal silicide, as required by independent claim 1, or with the selective deposition of a contact material, as required by independent claim 20.

In this regard, Chen merely teaches that “a blanket chemical vapor deposition is carried out . . . to form a TiN layer” subsequent to the selective deposition of a TiSi₂ layer. Col. 3, lines 20-23. Contrary to the Office’s assertion, the term “subsequent” implies nothing more than that the blanket deposition of TiN occurs *after* TiSi₂ is selectively deposited. This is clear from the meaning of the term “subsequent”: “[f]ollowing in time or order; succeeding.” American Heritage College Dictionary, Third Ed. (1997). Assuming, for the sake of argument, that the term “subsequent” actually implied that two adjacent-in-time processes were effected *in situ*, the terms “then” and “next,” which have the same meaning as “subsequent,” would also imply that adjacent-in-time processes are effected *in situ*. Continuing with the Office’s reasoning, as Chen uses “then,” “next,” or “subsequent” between each pair of adjacent-in-time processes disclosed therein, Chen impliedly teaches that all of all of the disclosed processes are effected *in situ*. This argument has no basis however, as no single apparatus includes a chamber that is capable of being used to form photomasks, etch, and deposit material layers. As such, it is respectfully submitted that Chen lacks any teaching, suggestion, or implication that the TiSi₂ and TiN deposition processes disclosed therein may be effected *in situ*.

The teachings of Danek are limited to forming one or more layers from a single diffusion material (*i.e.*, a binary metal nitride or a ternary metal silicon nitride (*see, e.g.*, col. 4, lines 8-12)), annealing, and oxidizing the diffusion material or exposing it to silane, all *in situ*. Like Chen, Danek does not teach or suggest that a diffusion material may be deposited *in situ* with the selective deposition of a metal silicide or a contact material.

Therefore, it is respectfully submitted that, under 35 U.S.C. § 103(a), independent claims 1 and 20 recite subject matter which is allowable over the teachings of Chen and Danek, taken either collectively or separately.

Claims 8-10, 12-14, 18, and 19 are each allowable, among other reasons, for depending directly or indirectly from claim 1, which is allowable.

Each of claims 23 and 25-28 is allowable, among other reasons, for depending directly or indirectly from claim 20, which is allowable.

Chen, Danek, and Chang

Claims 2-5, 21, and 22 have been rejected under 35 U.S.C. § 103(a) for being directed to subject matter which is allegedly unpatentable over teachings from Chen, in view of the subject matter taught in Danek and, further, in view of the teachings of U.S. Patent 5,043,299 to Chang et al.

Claims 2-5 are each allowable, among other reasons, for depending directly or indirectly from claim 1, which is allowable.

Claims 21 and 22 are both allowable, among other reasons, for depending directly and indirectly, respectively, from claim 20, which is allowable.

Claim 22 is further allowable since none of Chen, Danek, or Chang, taken collectively or individually, teaches or suggests exposing a semiconductor device structure to a nitrogen-ammonia plasma. While the Office has asserted, at page 5 of the Office Action of January 21, 2005, that use of a nitrogen-ammonia plasma would be obvious depending upon the type of material to be cleaned, the Office has not shown any art that discloses use of such a plasma. The Office's requirement that some unexpected result of the use of such a plasma be shown is misplaced, as the patent laws do not require a showing of unexpected results.

Chen, Danek, and Kolar

Claims 6 and 7 stand rejected under 35 U.S.C. § 103(a) for reciting subject matter which is purportedly unpatentable over the teachings of Chen, in view of teachings from Danek and, further, in view of the subject matter taught in U.S. Patent 5,162,259 to Kolar et al.

Claims 6 and 7 are both allowable, among other reasons, for depending directly and indirectly, respectively, from claim 1, which is allowable.

Chen, Danek, and Kim

Claims 11 and 24 stand rejected under 35 U.S.C. § 103(a) for reciting subject matter which is assertedly unpatentable over that taught in Chen et al., in view of the teachings of Danek and, further, in view of teachings from U.S. Patent 5,821,164 to Kim et al. (hereinafter “Kim”).

Claim 11 is allowable, among other reasons, for depending directly from claim 1, which is allowable.

Claim 24 is allowable, among other reasons, for depending directly from claim 20, which is allowable.

Furthermore, a *prima facie* case of obviousness has not been established against either claim 11 or claim 24. Kim has been relied upon for purportedly teaching that an interconnect material may be selectively deposited. The Office, however, has failed to cite any such teaching in Kim. Rather, the Office has cited col. 4, lines 24-27 (*see also* FIG. 2F), of Kim, which teaches a blanket (*i.e.*, nonselective) deposition process. The fact that the disclosed process is nonselective is evidenced by the fact that it must be followed by an etch-back, as explained at col. 4, lines 28-31 of Kim. As claims 11 and 24 both require that an interconnect material be selectively deposited, the teachings of Kim cannot be combined with teachings from Chen and Danek to establish a *prima facie* case of obviousness against either of these claims.

Chen, Danek, and Shinriki

Claims 15-17 stand rejected under 35 U.S.C. § 103(a) for reciting subject matter which is allegedly unpatentable over the subject matter taught in Chen, in view of teachings from Danek and, further, in view of the teachings of U.S. Patent 6,001,729 to Shinriki et al.

Claims 15-17 are each allowable, among other reasons, for depending directly or indirectly from claim 1, which is allowable.

It is respectfully requested that the 35 U.S.C. § 103(a) rejections of claims 1-28 be withdrawn.

CONCLUSION

It is respectfully submitted that each of claims 1-28 is allowable. An early notice of the allowability of each of these claims is respectfully solicited, as is an indication that the above-referenced application has been passed for issuance. If any issues preventing allowance of the above-referenced application remain which might be resolved by way of a telephone conference, the Office is kindly invited to contact the undersigned attorney.

Respectfully submitted,



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